Python

Aliasing

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Often easier (and more useful) than making a second copy

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Because the data can't change

But if data *can* change, aliases can result in a lot of hard-to-find bugs

Aliasing happens whenever one variable's value is assigned to another variable

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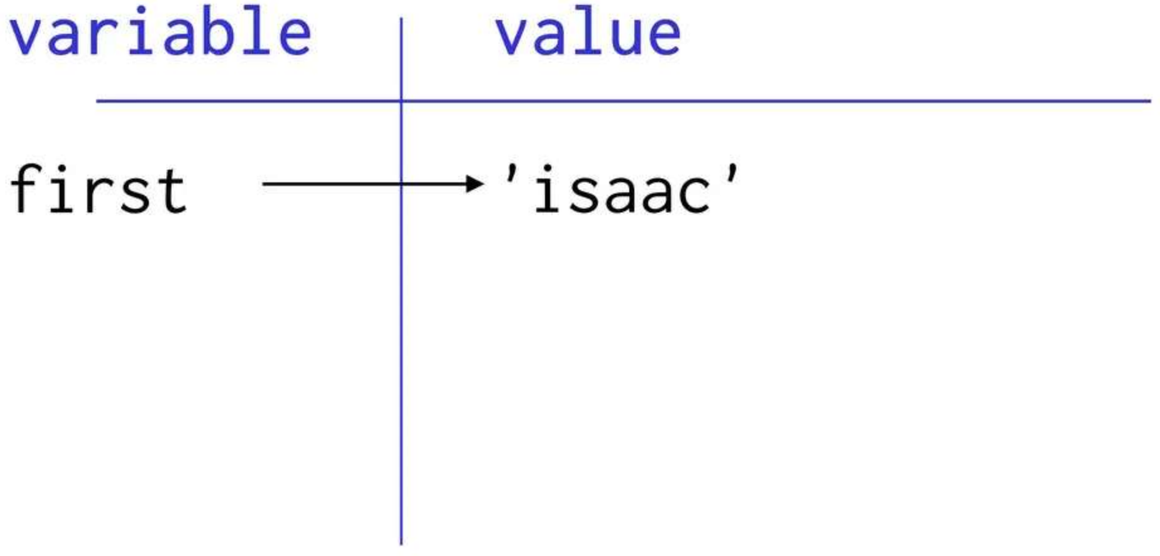
```
first = 'isaac'
```



Aliasing happens whenever one variable's value is assigned to another variable

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first = 'isaac'
second = first
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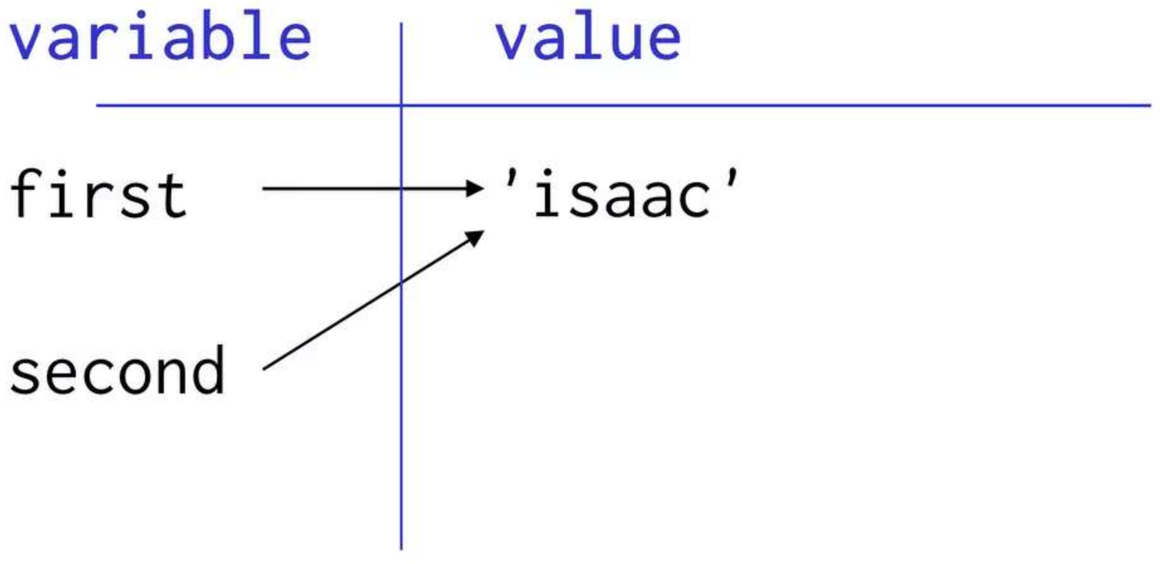

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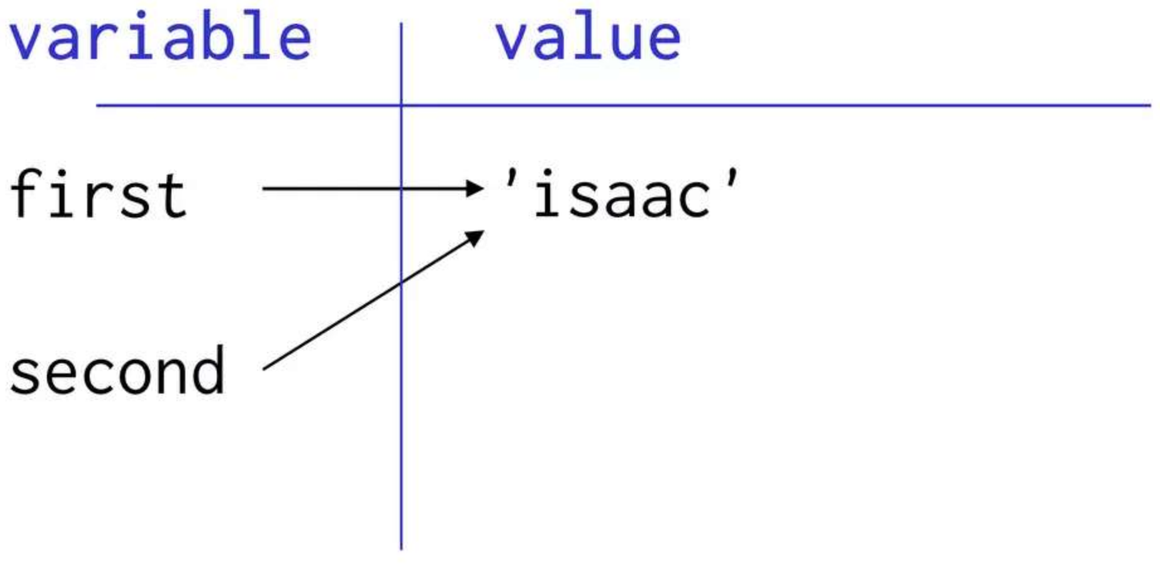
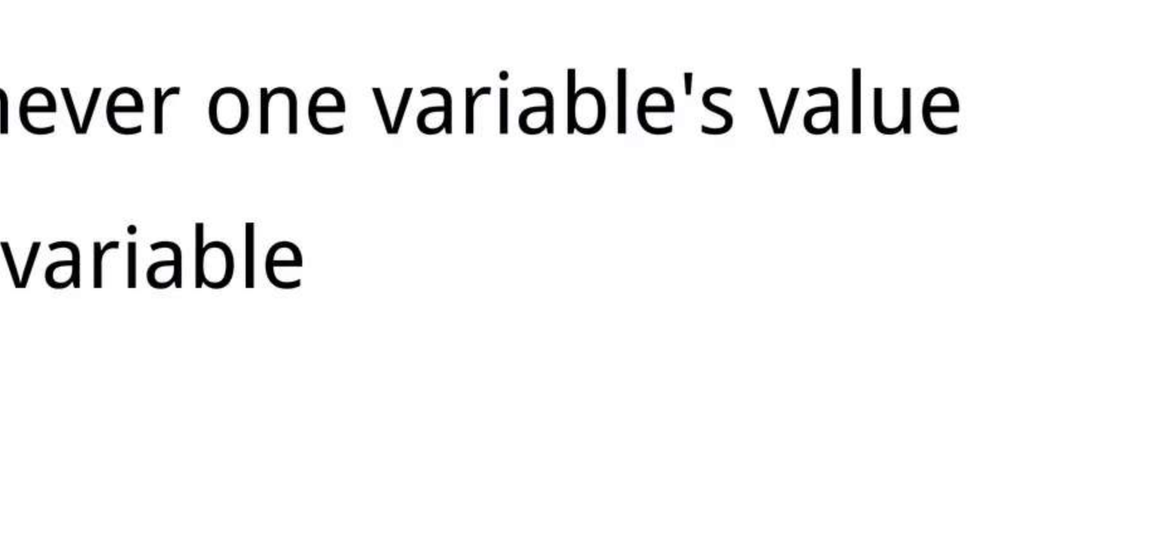


Aliasing happens whenever one variable's value is assigned to another variable

```
first = 'isaac'
second = first
```

But as we've already seen...

```
first = first + ' newton'
```



But lists are mutable

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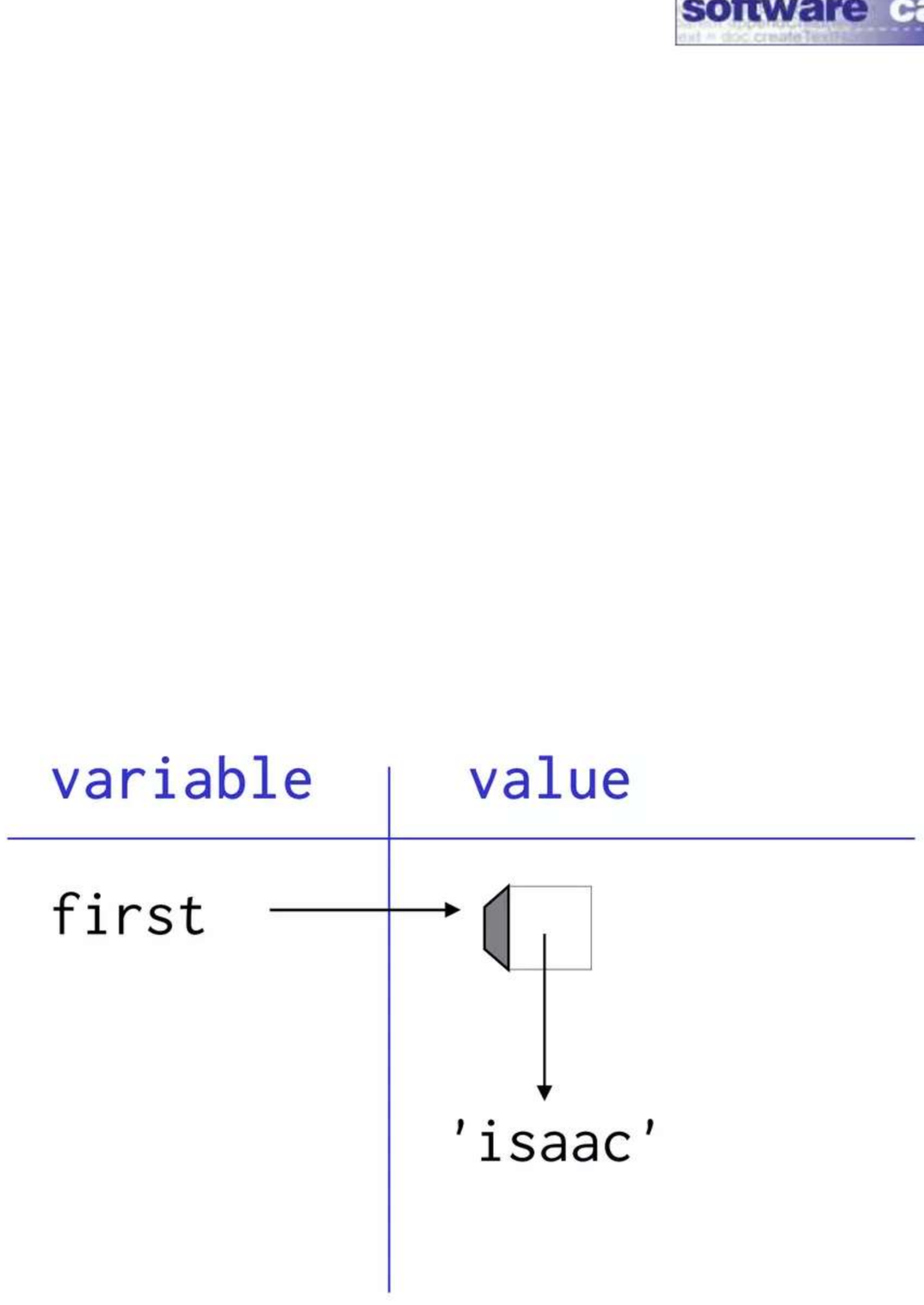

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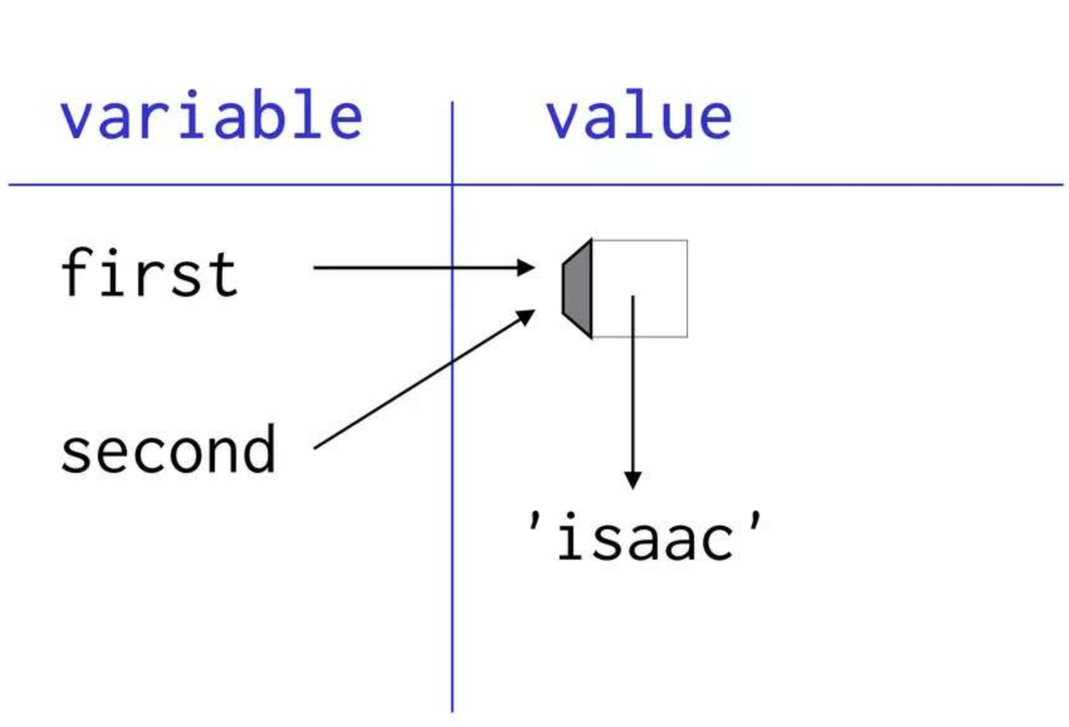
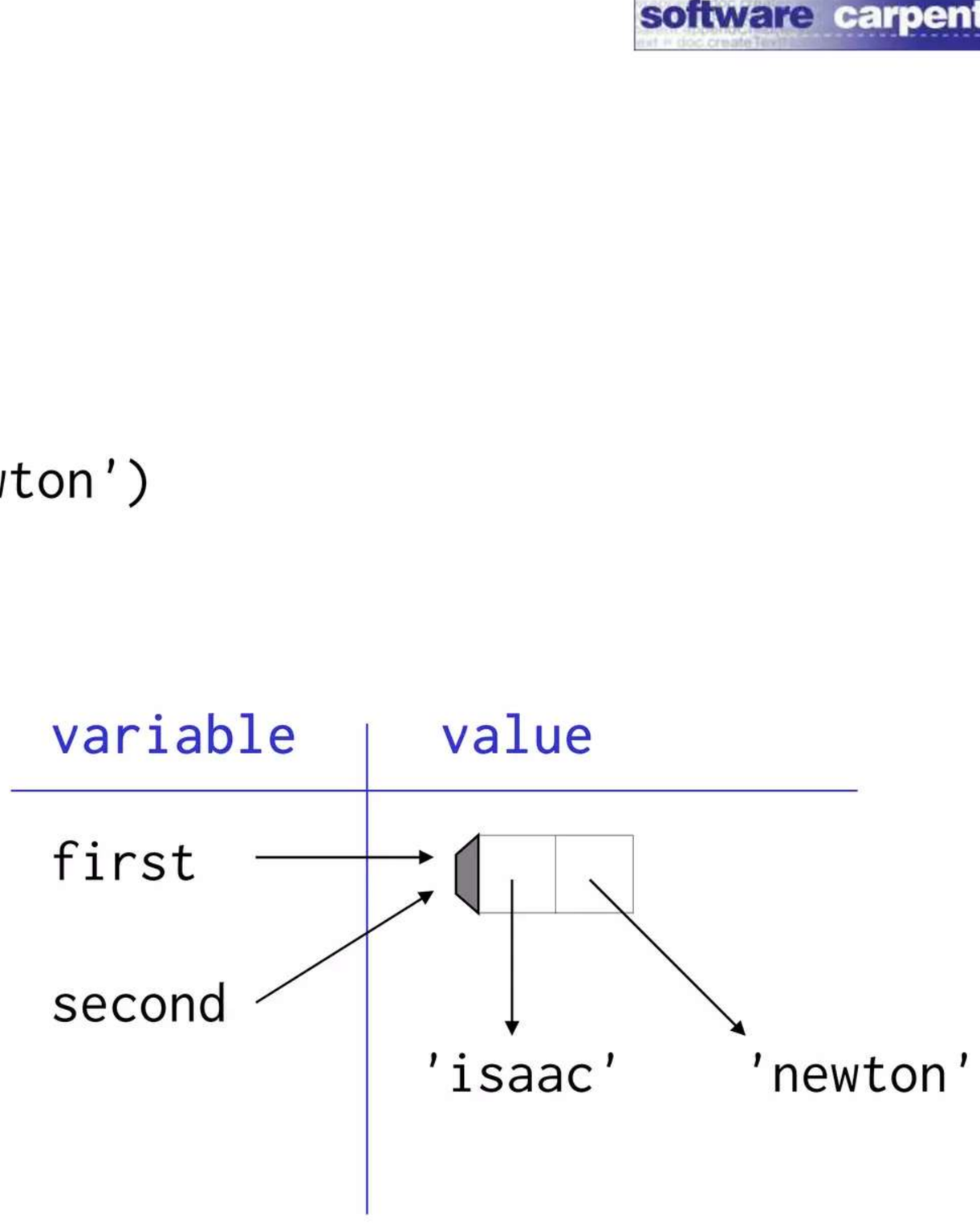


But lists are mutable

```
first = ['isaac']
second = first
first = first.append('newton')
print first
['isaac', 'newton']
```



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second = first
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print first
['isaac', 'newton']
print second
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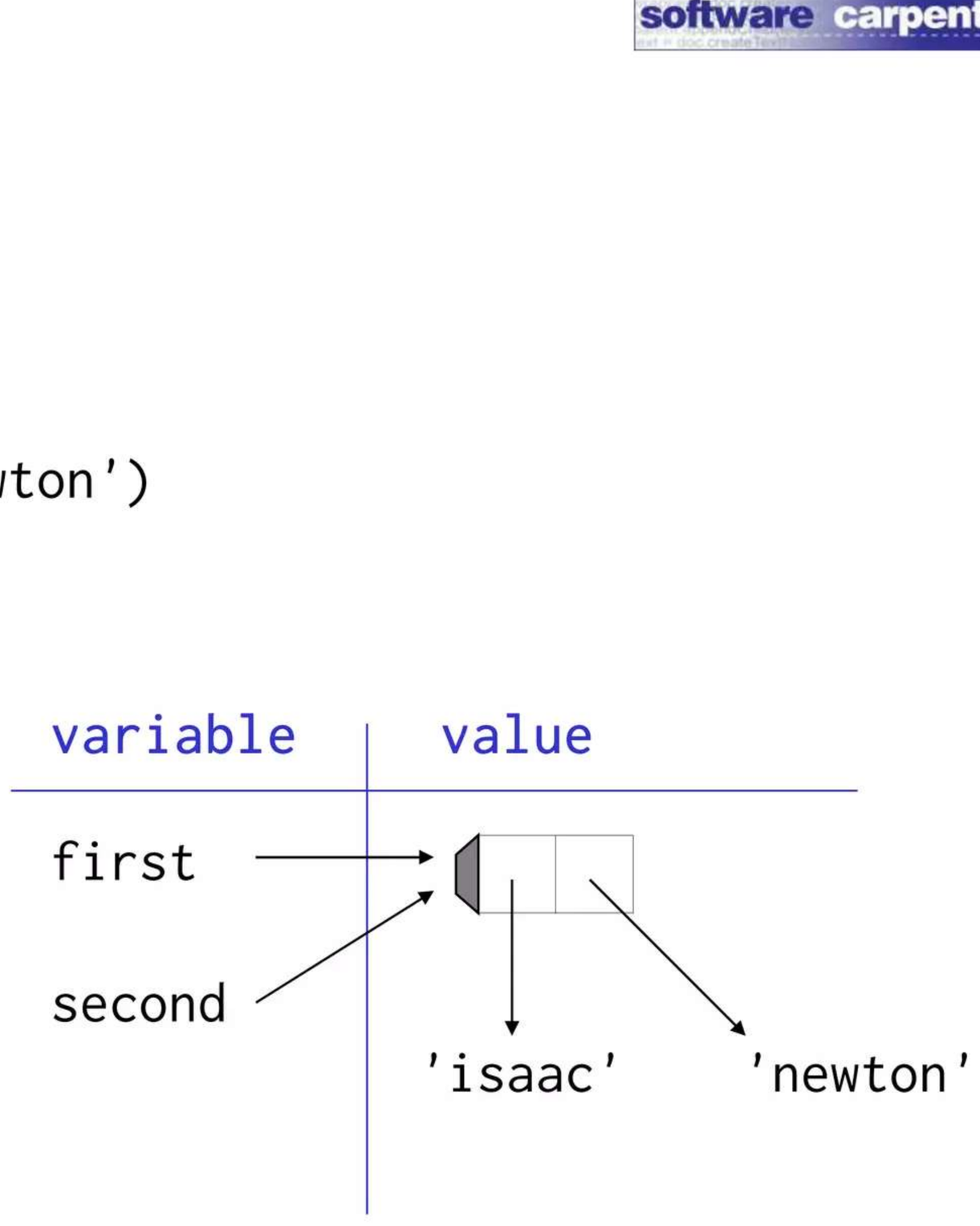

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first = first.append('newton')
print first
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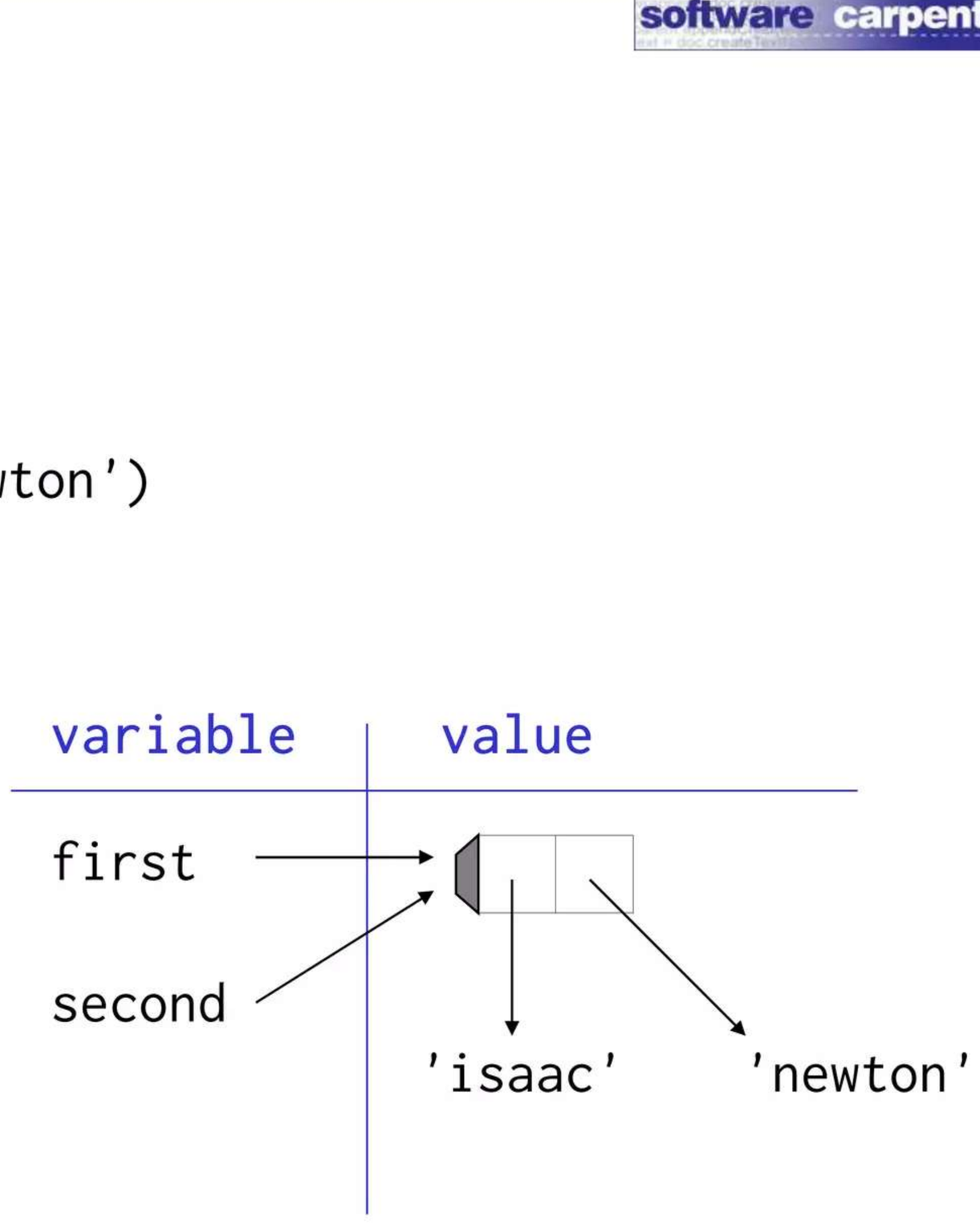
```

Didn't explicitly modify second



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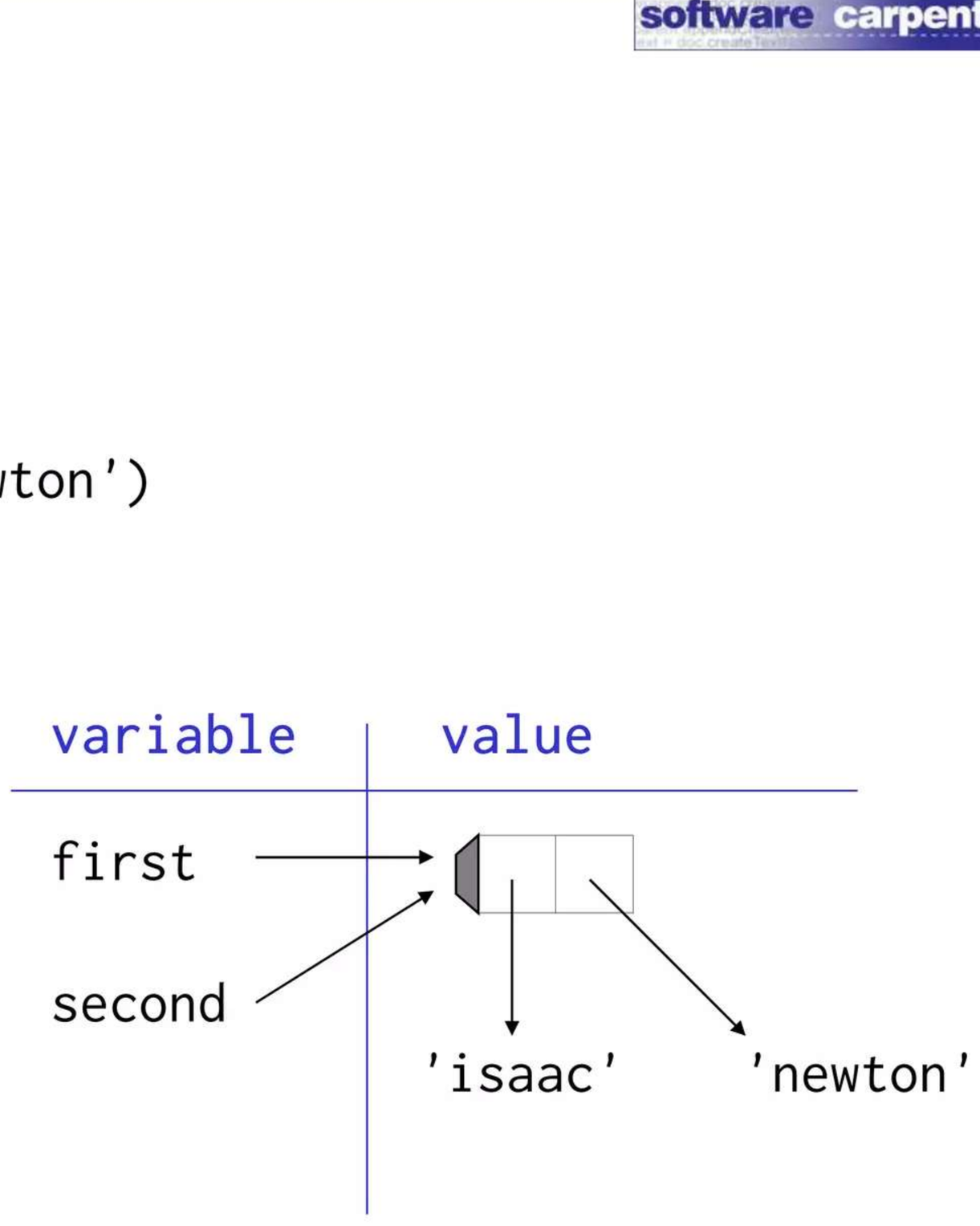
A *side effect*



Example: use lists of lists to implement a 2D grid

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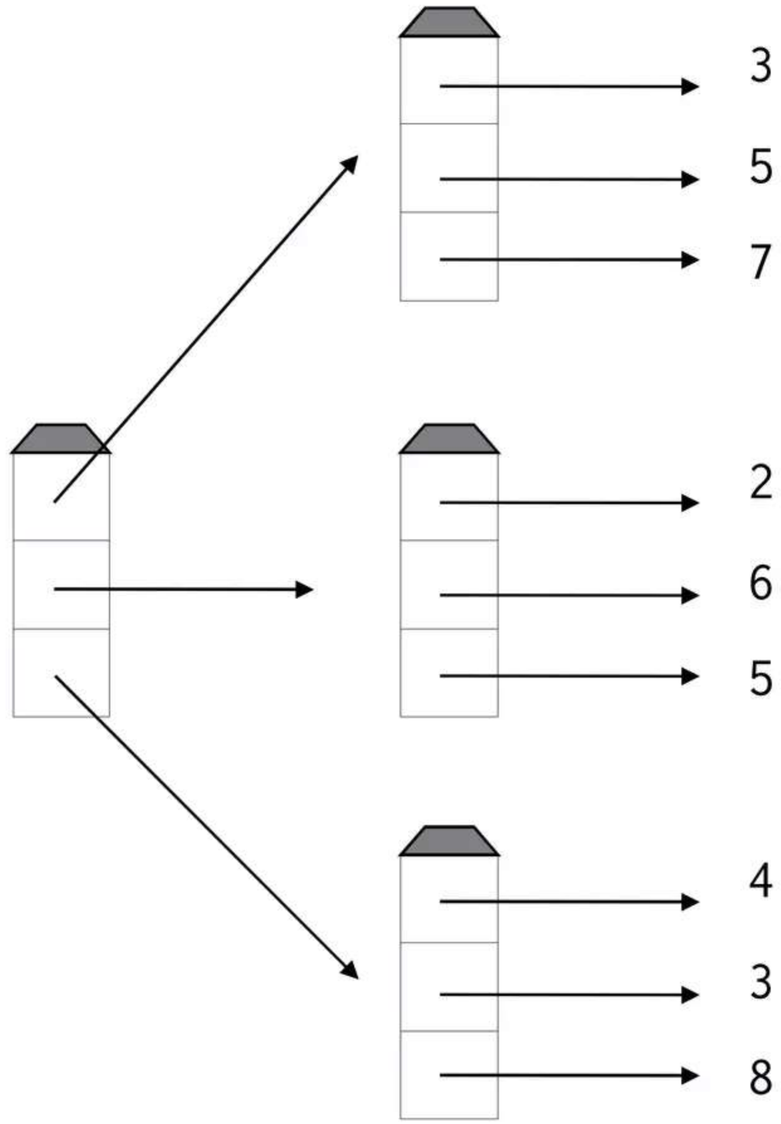
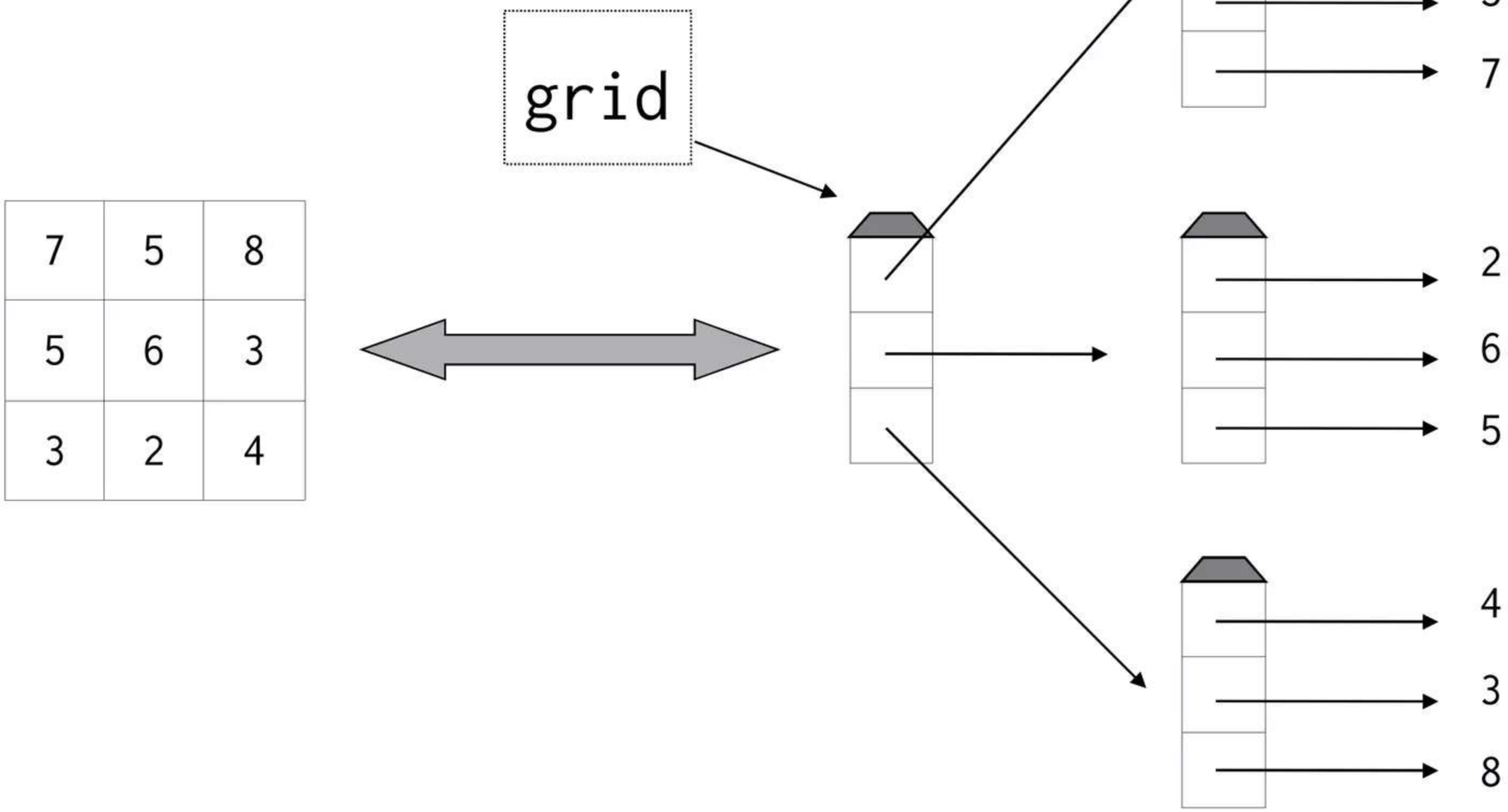
7	5	8
5	6	3
3	2	4



Example: use lists of lists to implement a 2D grid



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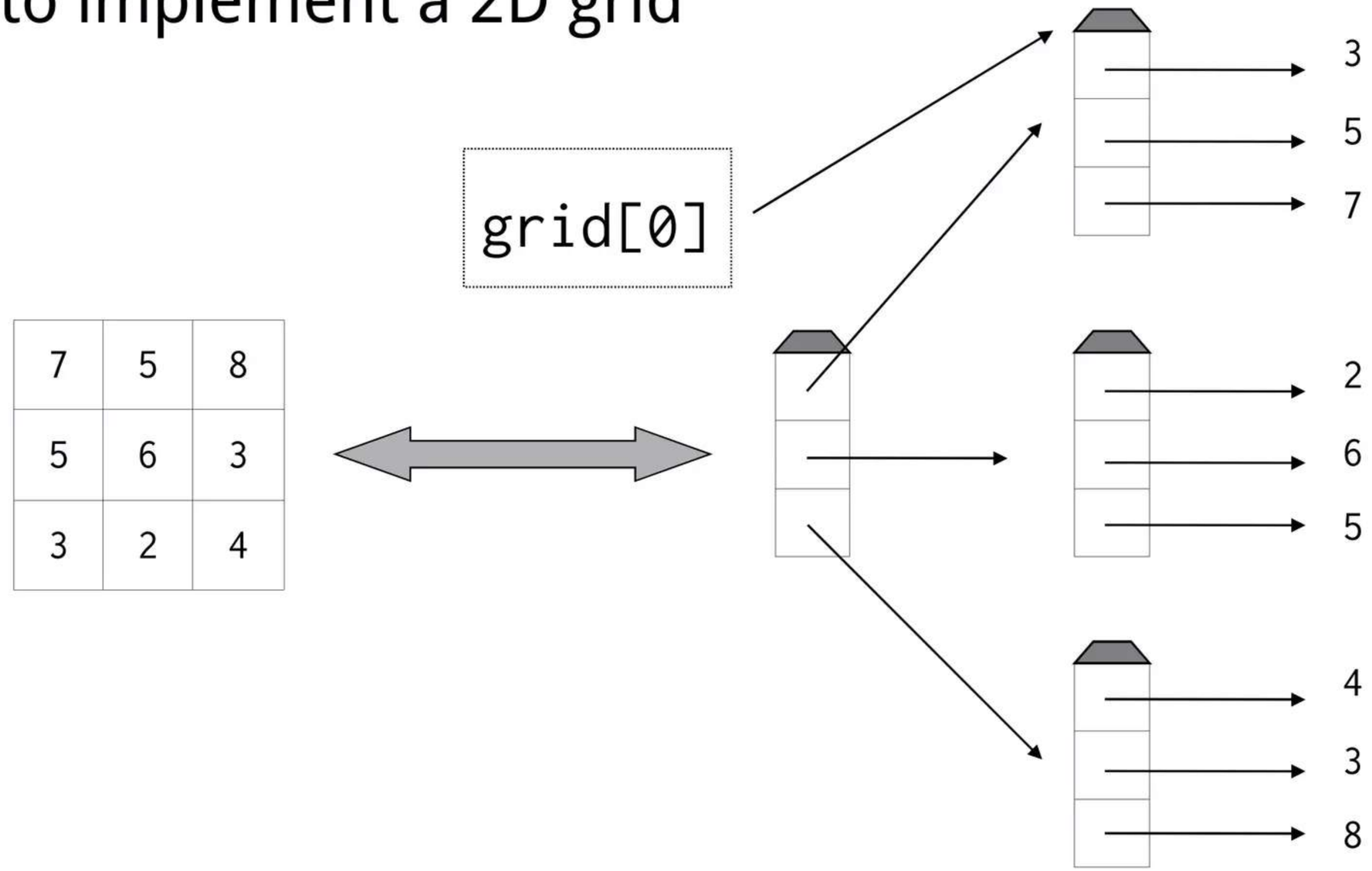

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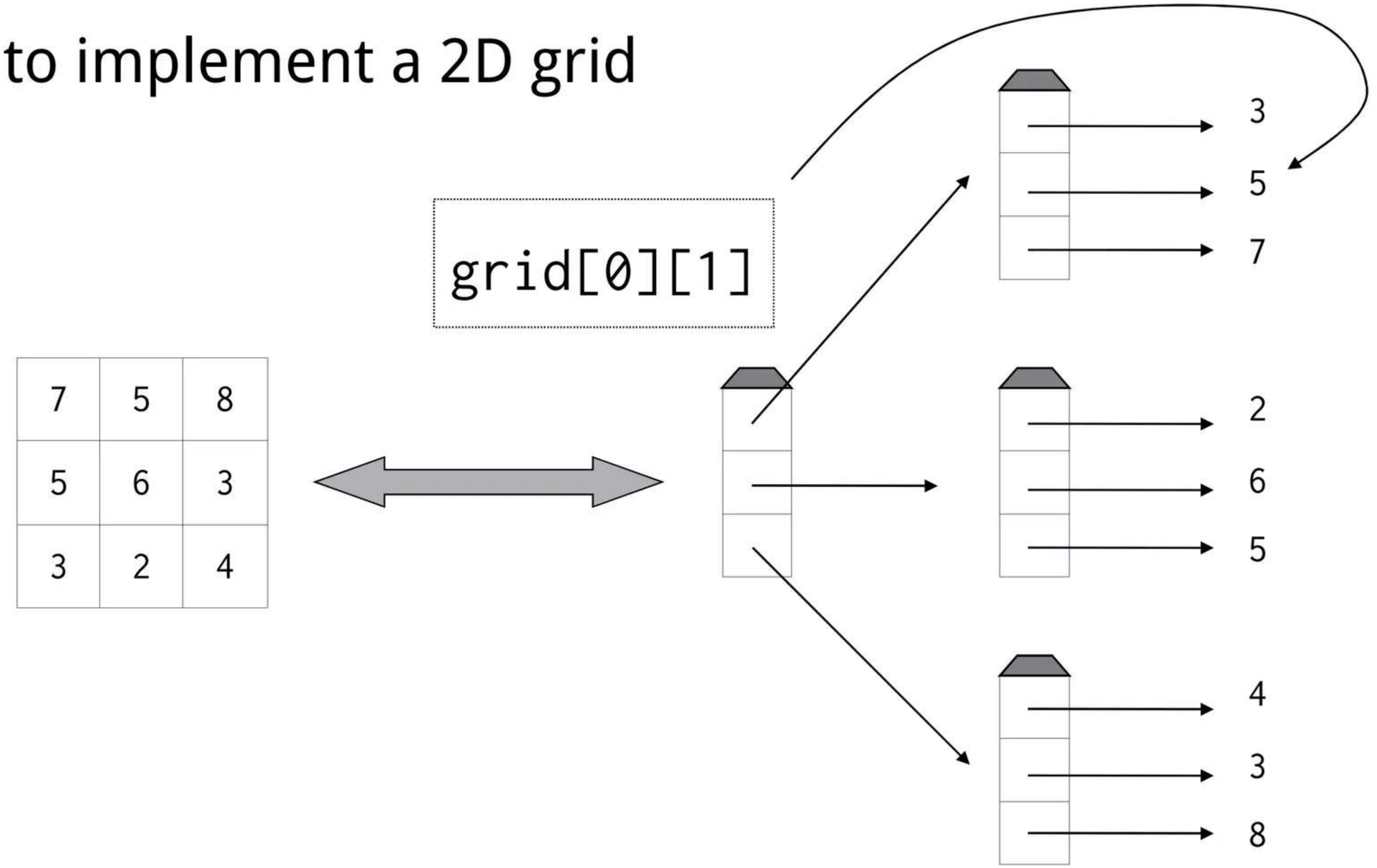

```
# Correct code
grid = []
for x in range(N):
  temp = []
  for y in range(N):
    temp.append(1)
  grid.append(temp)
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Outer "spine" of structure

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Add N sub-lists to outer list

```
# Correct code
grid = []
for x in range(N):
    temp = []
    for y in range(N):
        temp.append(1)
    grid.append(temp)
```

← Create a sublist of N 1's

```
# Equivalent code
grid = []
for x in range(N):
  grid.append([])
  for y in range(N):
    grid[-1].append(1)
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grid = []
for x in range(N):
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Last element of outer list is the sublist currently being filled in

```
# Incorrect code
grid = []
EMPTY = []
for x in range(N):
  grid.append(EMPTY)
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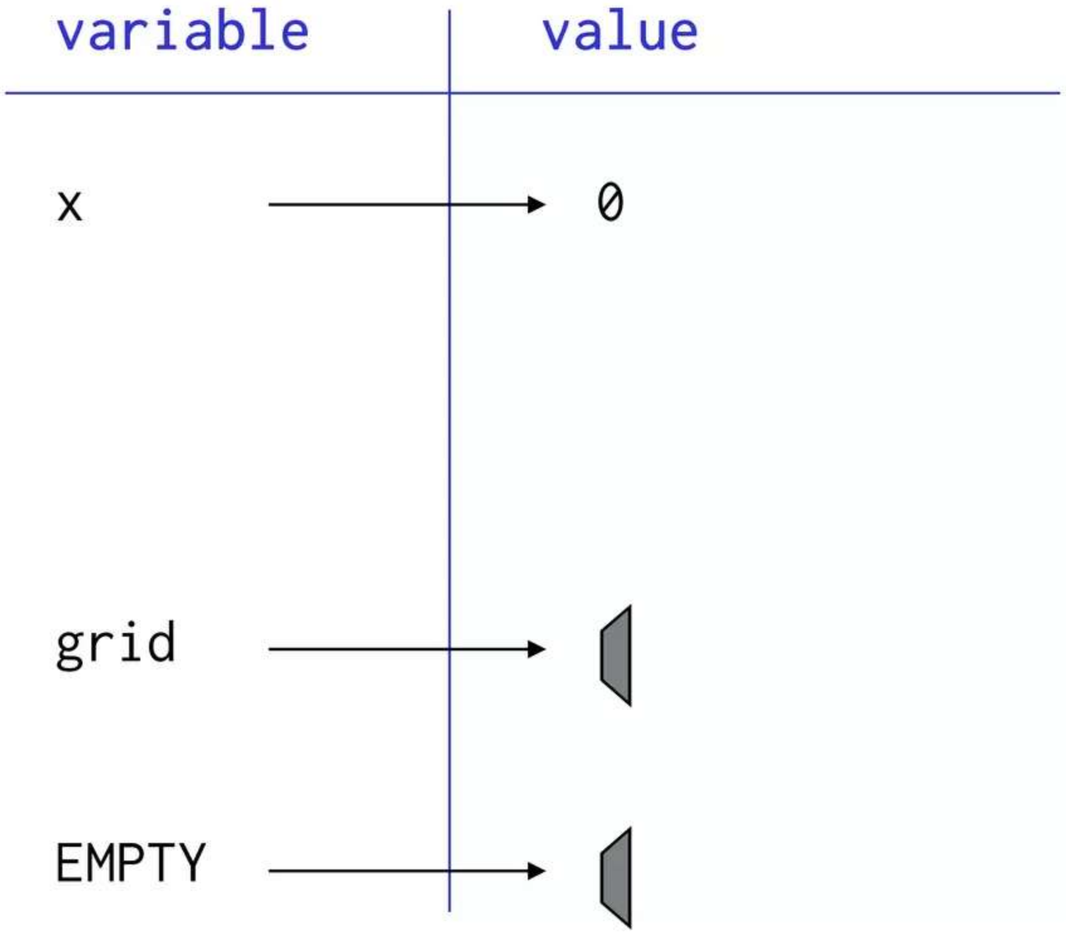
Aren't meaningful variable names supposed to be a good thing?

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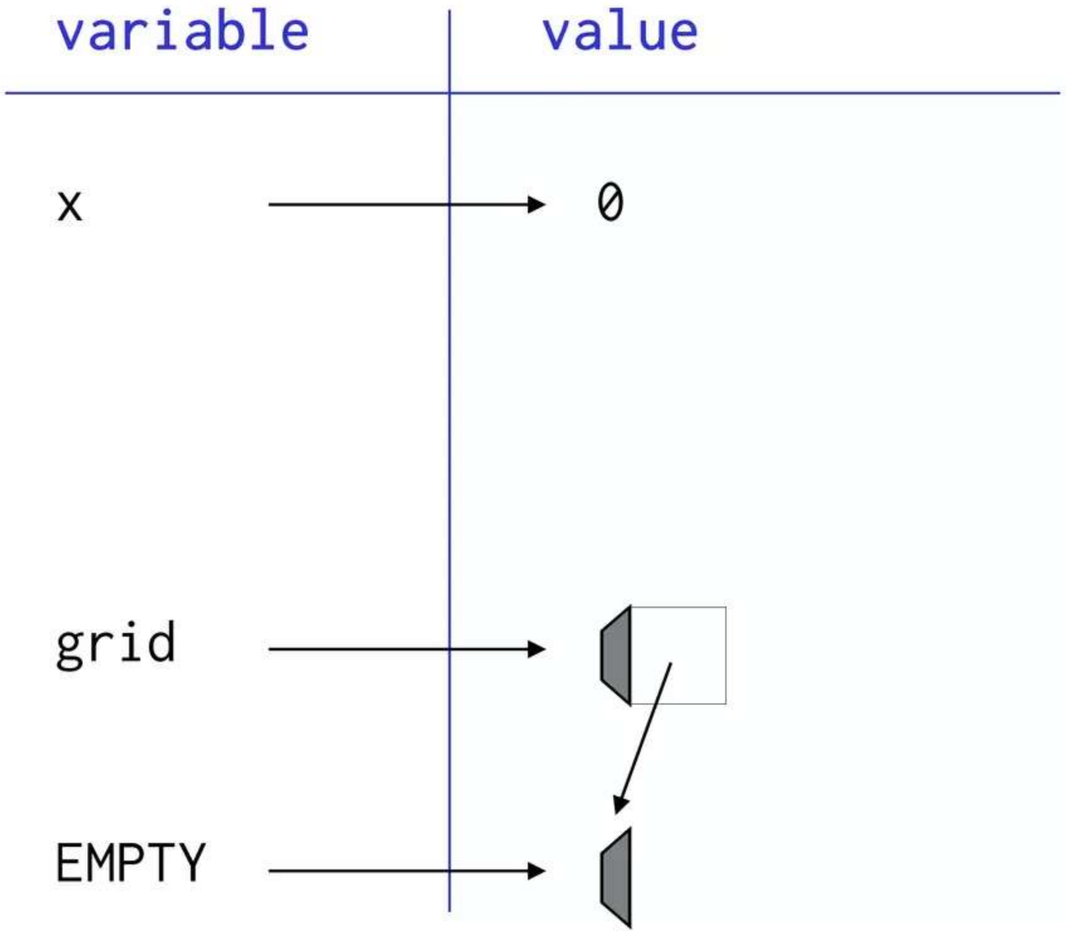


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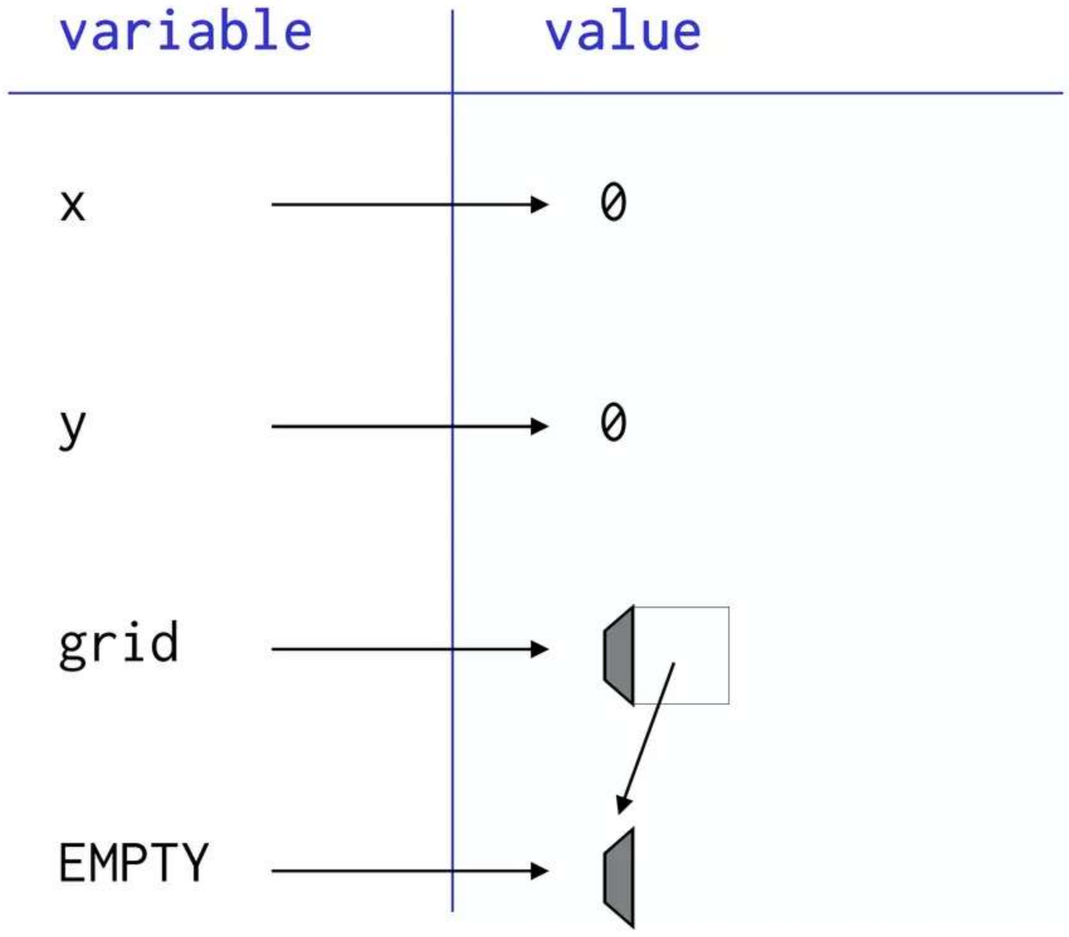


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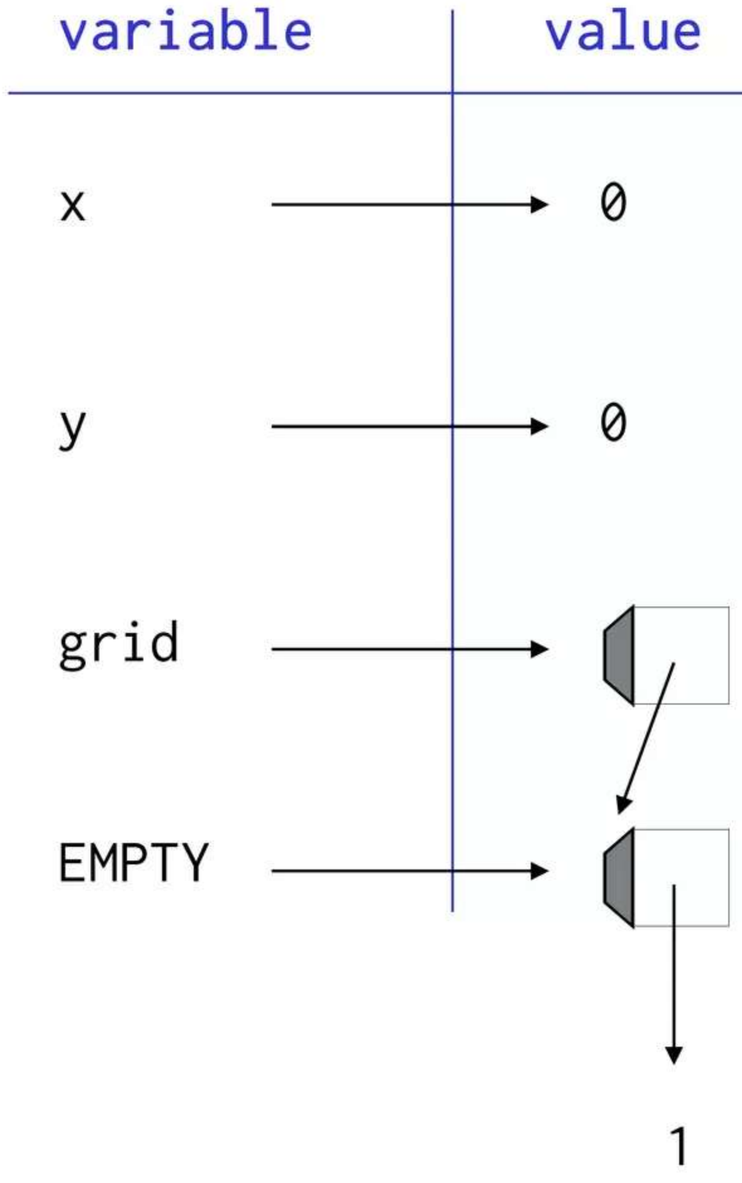


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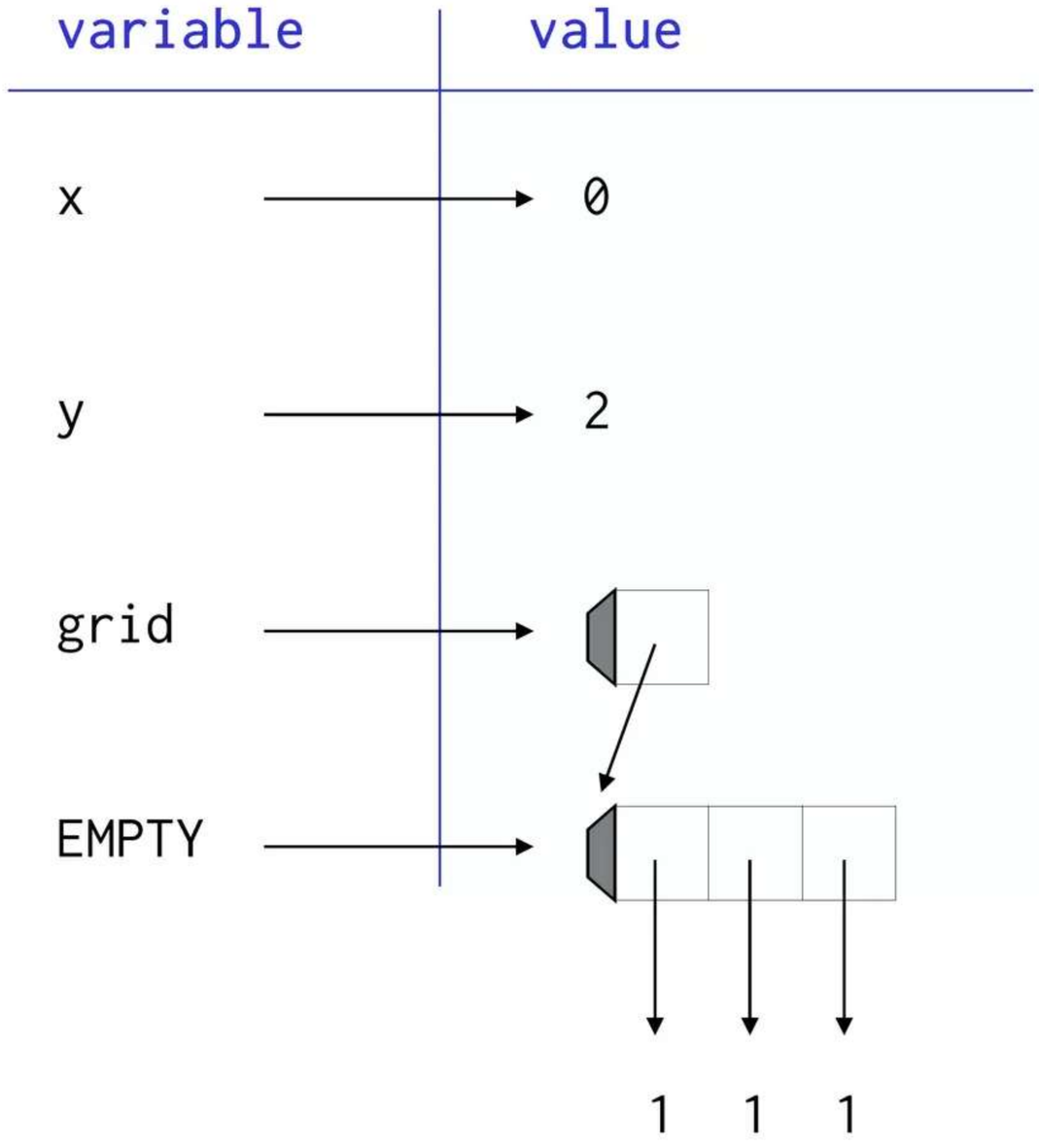


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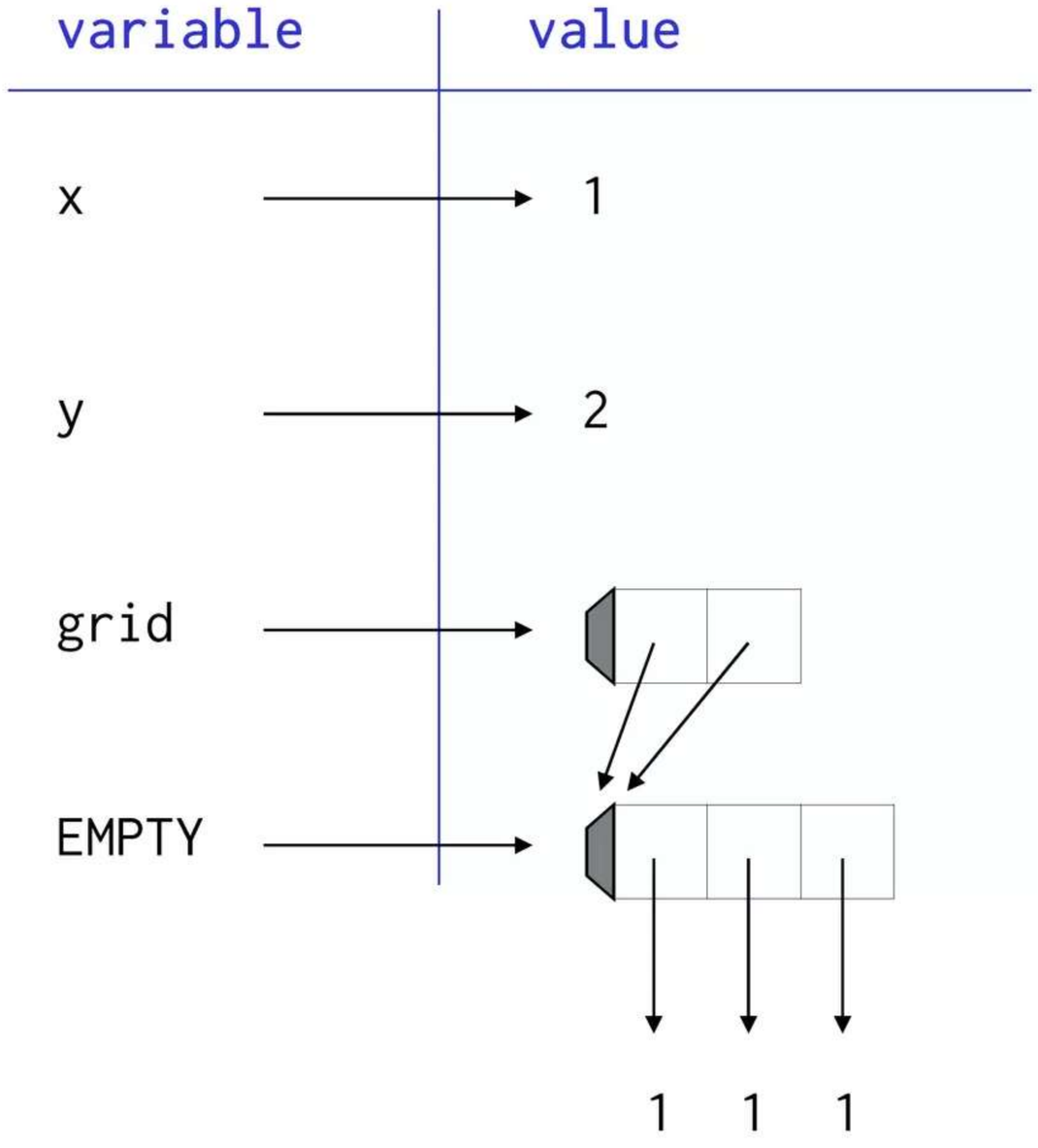


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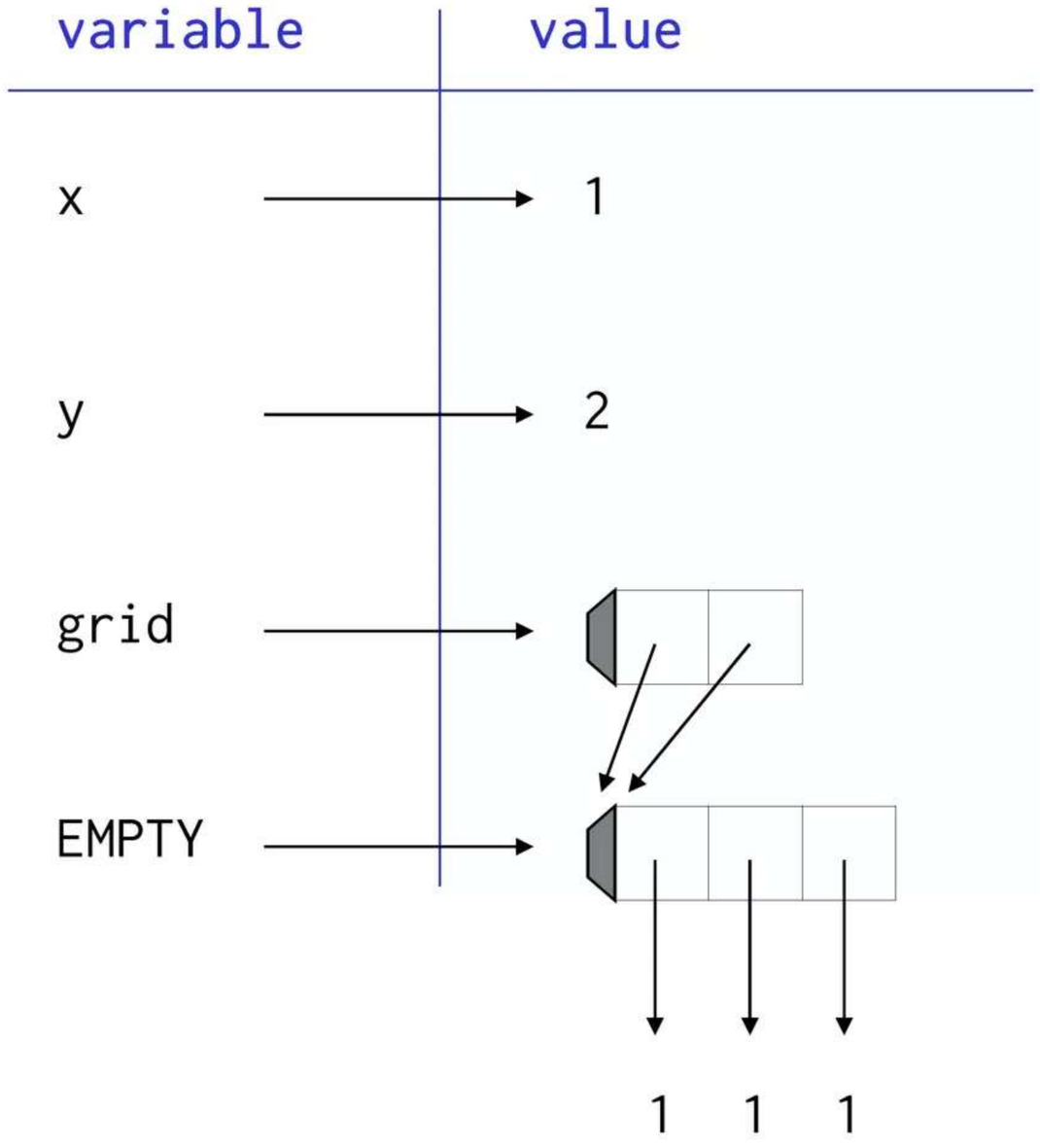


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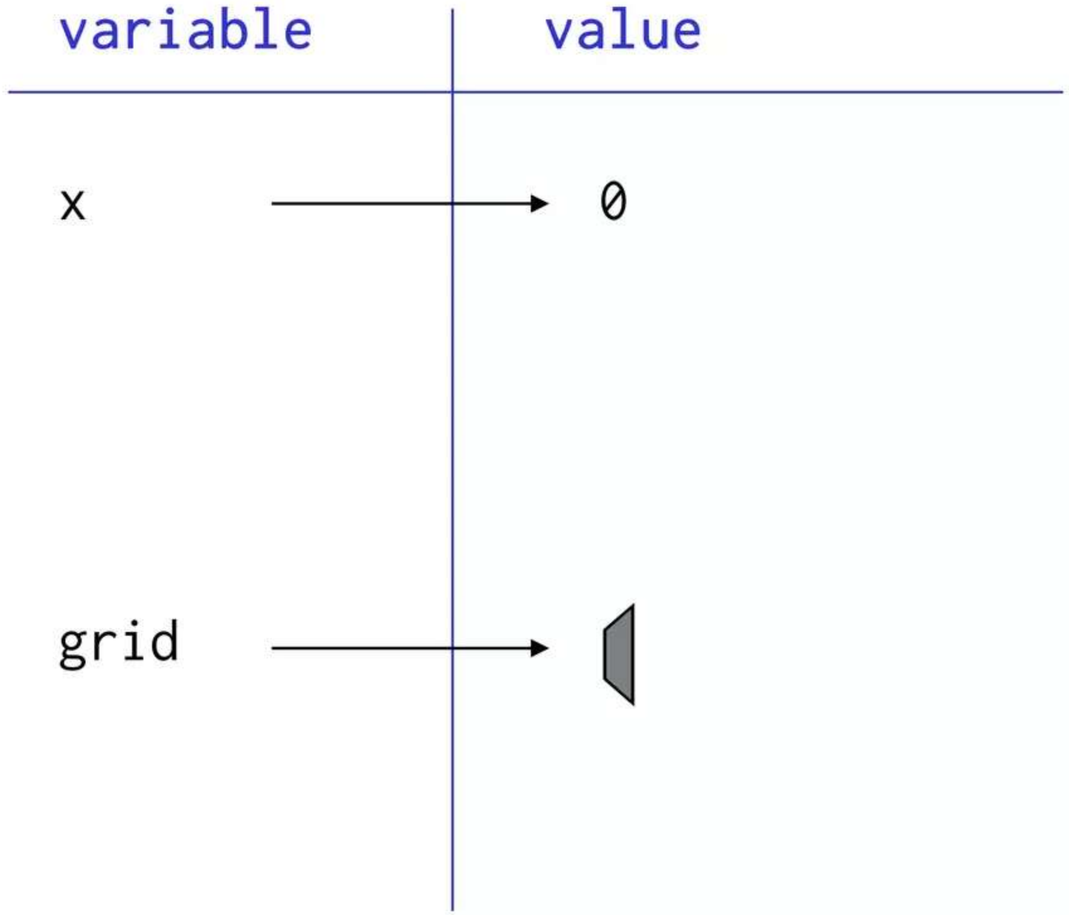
You see the problem...

No Aliasing

```
first = []

second = []
```

No Aliasing	Aliasing
`first = []`	`first = []`
`second = []`	`second = first`

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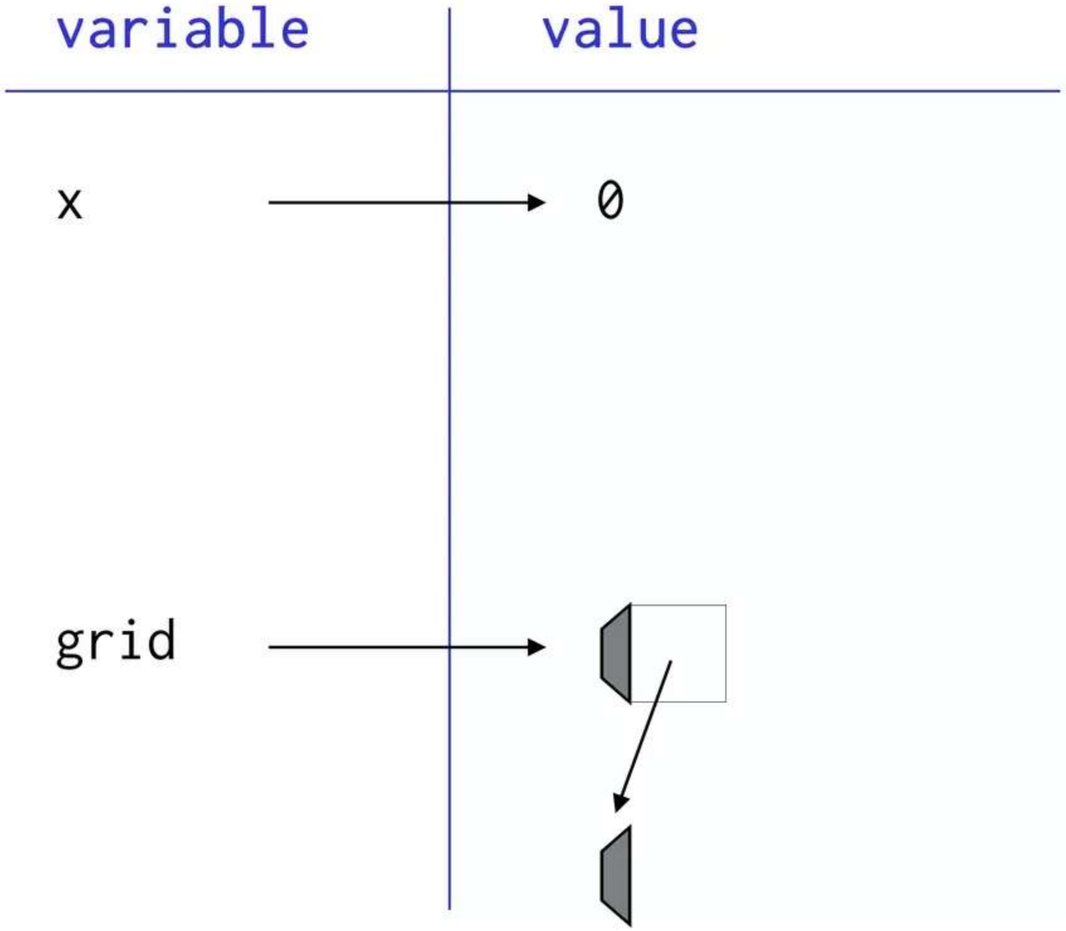


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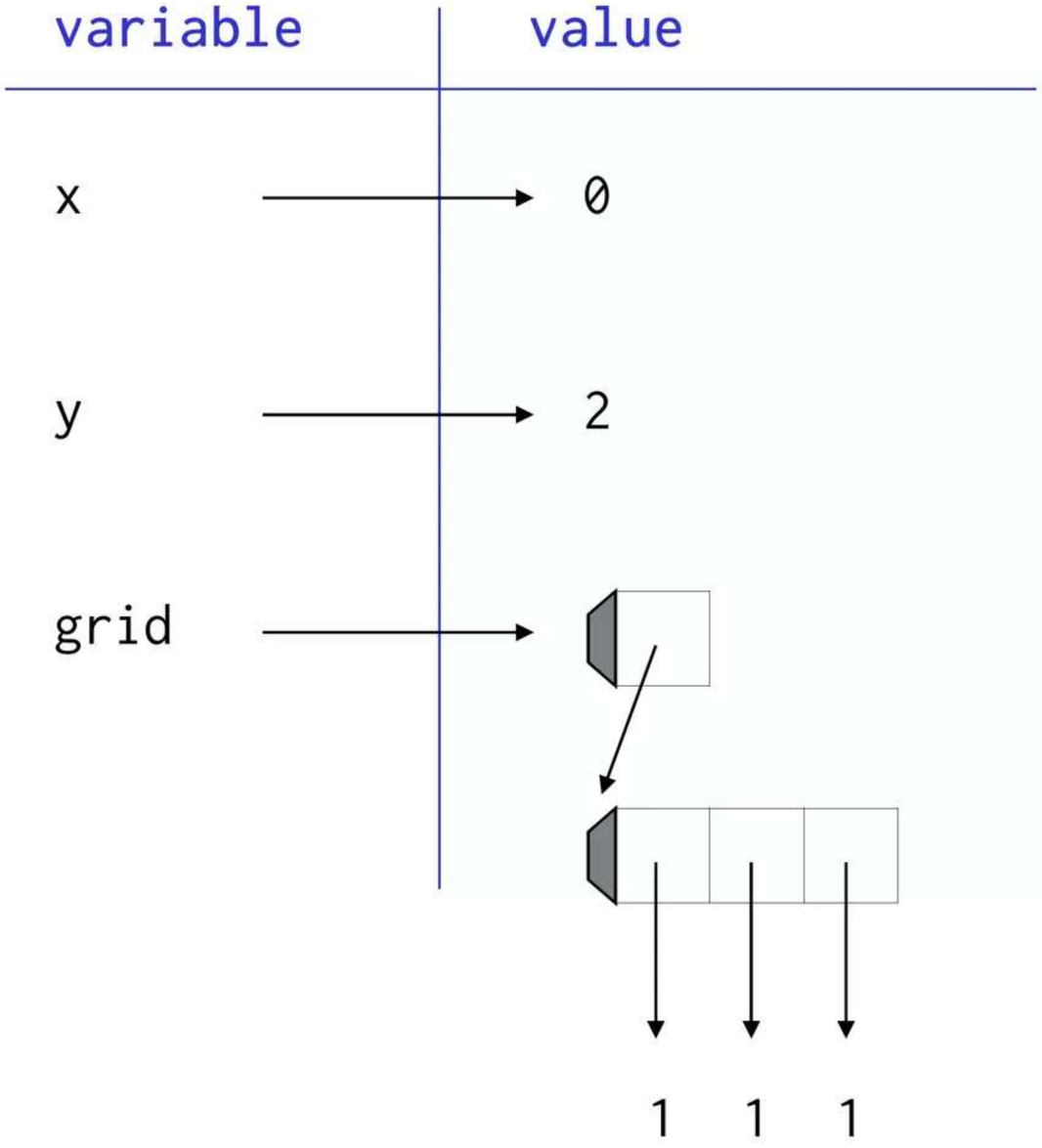


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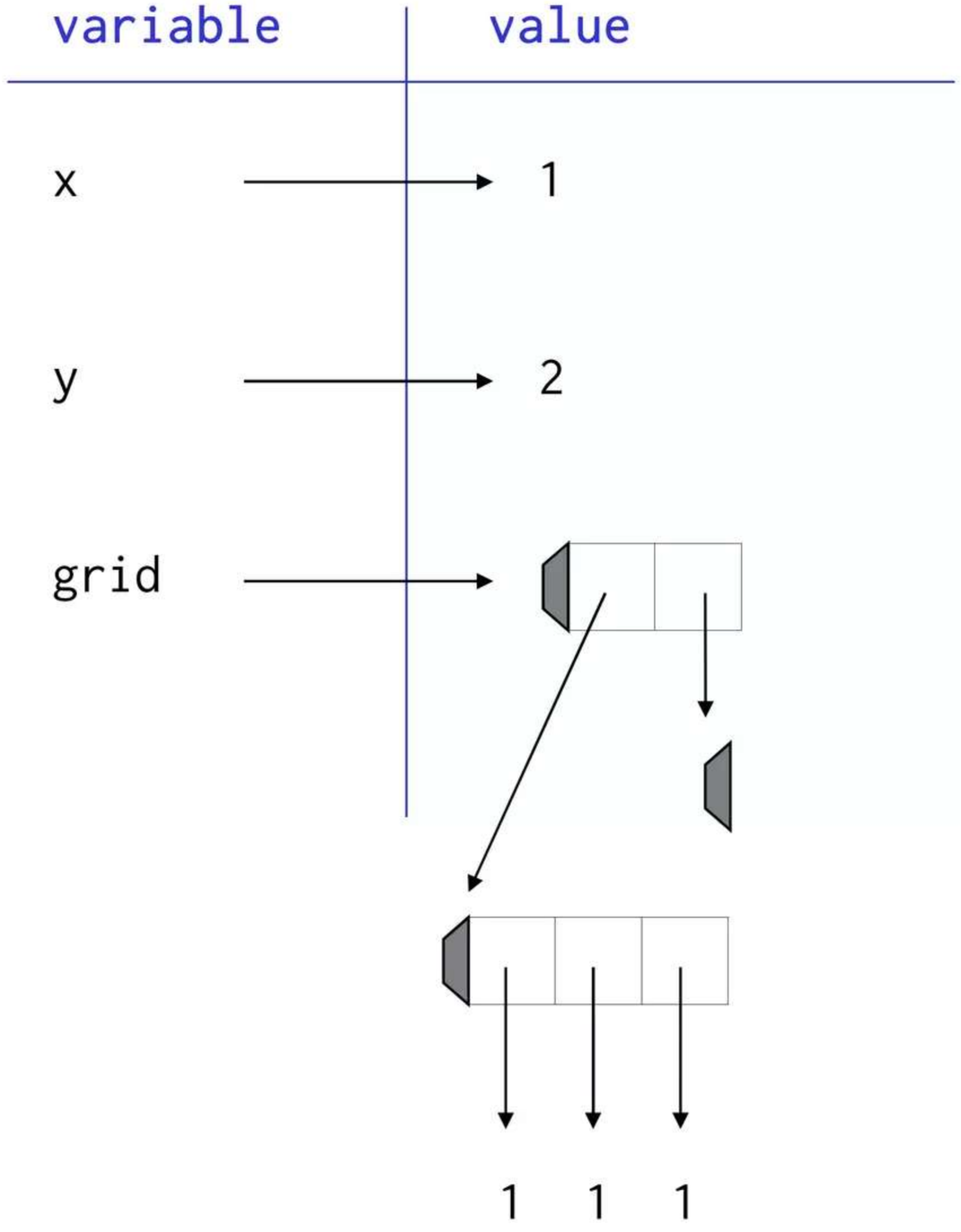


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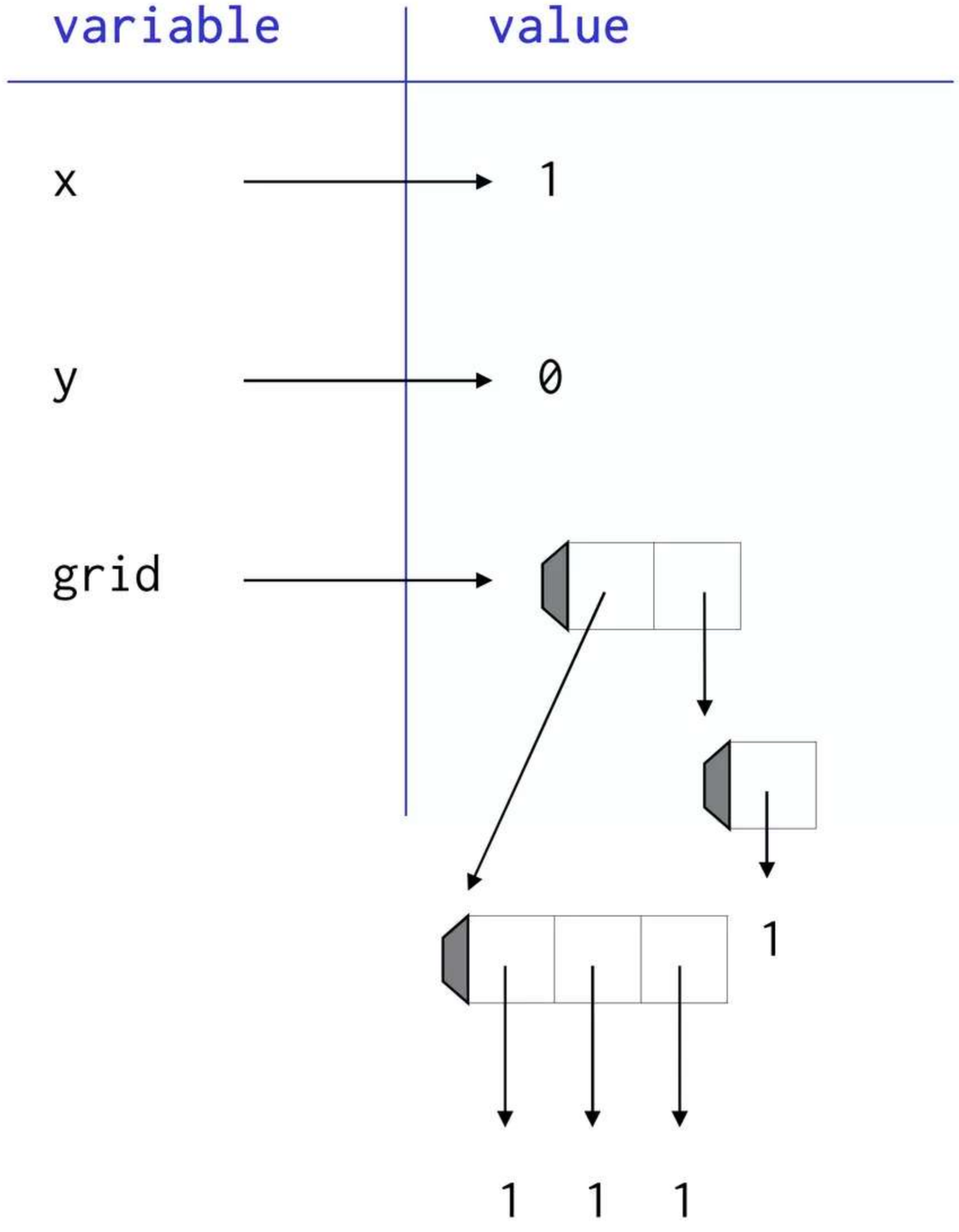


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If aliasing can cause bugs, why allow it?

1. Some languages don't

   Or at least appear not to

2. Aliasing a million-element list is more efficient than copying it

3. Sometimes really do want to update a structure in place